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WATER QUALITY OF THE NONQUON RIVER IN RELATION TO SEWAGE LAGOON DISCHARGE FROM PORT PERRY

REGIONAL MUNICIPALITY OF DURHAM



Ontario

Ministry
of the
Environment

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Director
Central Region

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WATER QUALITY OF THE
NONQUON RIVER IN RELATION TO
SEWAGE LAGOON DISCHARGE
FROM PORT PERRY

REGIONAL MUNICIPALITY OF DURHAM

MAY - - 1976

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SUMMARY

During the summer of 1975, a water-quality survey for Nonquon River was conducted to determine the impact of controlled discharges of effluent from the Port Perry lagoons on stream-flow quality, and what acceptable BOD₅ loads could be accommodated by the river at various times during the year.

The study included water-quality monitoring at selected locations on the Nonquon River from a point upstream of the sewage outfall to the Hamlet of Seagrave, and estimating design flows for the river near Port Perry (Station #1/02HG101).

Water quality in the Nonquon River upstream of the sewage outfall was found to have nutrient concentrations which could cause biological nuisances and suspended solids concentrations more than the 15 mg/l. The high nutrient levels were probably due to decomposing vegetable matter which was abundant in the stream bed.

Samples of the effluent from the Port Perry lagoons varied widely in quality, especially in terms of BOD₅ which sometimes exceeded 15 mg/l. Nutrient and suspended solids concentrations also fluctuated substantially. As a result, the impact of the effluent discharge on downstream water quality was not found to be a direct function of the discharge rate.

Stream-flow velocities for the Nonquon River during the survey were found to be too low to be measured by the instruments. According to spot measurements of flows during 1973 and 1974, "zero" flows were recorded. Estimates

of minimum flows averaged over seven consecutive days for various return periods (e.g. $7Q_{10}$ - seven day minimum flow for a recurrence interval of 10 years) yielded flows during the summer and fall that were in the range of one to two cubic feet per second at Station #1.

In assessing the capability of the Nonquon River to satisfactorily assimilate sewage from Port Perry in terms of BOD₅, dissolved oxygen and nutrient, it appeared that there were, at best, limited capacities during all months with the probable exception of March, April & May. The present inflow to the lagoons is about 0.32 MGD. Provided that the effluent quality with respect to BOD₅ and phosphorus concentrations is maintained at 15 mg/l and 1.0 mg/l respectively, it is considered that a daily lagoon discharge, equivalent to the present daily sewage flow of about 0.32 MGD, can be safely assimilated by the Nonquon River during the period November to May. However, the volume of sewage generated during the period June to October should be retained in the sewage lagoons for subsequent discharge.

RECOMMENDATIONS

1. The sewage should be chemically treated to reduce the BOD₅ concentration to at least 15 mg/l prior to being discharged.
2. Phosphorus concentrations in the final effluent should be reduced to 1 mg/l or less from the levels measured during the 1975 survey.
3. During the months from June to October inclusive, no effluent should be discharged to the Nonquon River.
4. During the five month period from November to March a continuous effluent discharge with a maximum BOD₅ load of 50 lbs. per day to the Nonquon River should be allowed. Under winter conditions, the final effluent should be aerated prior to being discharged.
5. The sewage accumulated in the lagoon during the remainder of the year should be batch-chemically treated and discharged during the high-flow period in spring such that the design loads established in Table 2 are not exceeded.

CONCLUSIONS

1. Stream flows for the Nonquon River near Port Perry (abandoned Station 02HG101) were low. During dry years, summer and fall flows over extended periods

were estimated to be in the range of one to two cubic feet per second. Over short intervals, it would not be unusual for flows to decrease even further as had occurred on August 9 and 23, and September 13, 1974. Therefore, during summer and fall, the Nonquon River has little or no capacity to satisfactorily assimilate sewage effluent from Port Perry.

2. Nutrient concentrations, especially phosphorus, in the Nonquon River upstream of Port Perry (Station #1, Figure 1) were high and were probably due to decomposing vegetable matter which abounded in the stream bed.
3. The quality of the effluent during the 1975 summer survey indicated high concentrations of BOD₅, nutrients and suspended solids; bacterial counts exceeded this Ministry's recommended levels for body-contact recreational uses.
4. BOD₅ concentrations in the effluent varied widely for samples taken during the 1975 survey.
5. The impact of the effluent discharge from the Port Perry lagoons on the Nonquon River was significant, especially in terms of reducing dissolved oxygen levels.
 - a) Dissolved oxygen concentrations were frequently reduced to less than 4 mg/l as far as Station #4, about 6.5 miles downstream. The lowest concentrations of 0.8 mg/l and 1.4 mg/l were recorded for Stations #2 and #3 respectively.

- b) BOD₅ concentrations greater than 4 mg/l were recorded as far as Station #3, about 3.2 miles downstream.
- c) Nutrient levels in the Nonquon River downstream of the lagoons outfall increased, and were likely due in part to the effluent discharge from the Port Perry lagoons.

INTRODUCTION

This report was a result of a water-quality study designed to determine the impact of the sewage effluent discharges from the Port Perry lagoon system on the water quality in the Nonquon River.

To simulate "worst" conditions, the survey was carried out under the following conditions:

1. the sewage lagoons did not receive any chemical treatment
2. the effluent was discharged continuously
3. the rate of discharge was regulated to exceed periodically the rate of inflow to the lagoon system to assess the stream's assimilative capacity.

The water-quality data on which the study was based was collected at selected stations during the summer of 1975. The prime parameters considered were nitrogen (free ammonia, kjeldahl, nitrite and nitrate) total and soluble phosphorus, BOD₅, dissolved oxygen, fecal coliform, fecal streptococci, total coliform bacteria and suspended solids.

PHYSIOGRAPHY

The Nonquon River is bordered by gently rolling terrain in the form of a small section of kame moraine to the south and drumlinized till plains to the west and the north*. The stream, however, flows through very flat lands made up of sand plains west of Port Perry, and peat and muck downstream to Seagrave.

HYDROLOGY

The annual mean stream-flow yield for the Nonquon River Basin was estimated to be approximately 0.9 cubic feet per second (cfs) per square mile of drainage area. The drainage area for the Nonquon River near Port Perry is about 22 square miles (mi^2).

Most of the flow in the Nonquon River occurs in the spring when elevated water levels in the surrounding areas, provide the necessary hydraulic gradient. Throughout the rest of the year, flows are usually low and sluggish.

The only stream-flow station on the Nonquon River was at Highway #7 near Port Perry (#02HG101). Data for this station consisted of spot measurements made during the open-water

*CHAPMAN, L.J. and PUTNAM, D.F. (1972); Physiography of the South Central Portion of Southern Ontario - Map 2226.

periods for 1973 and 1974 (Table 1). The station was abandoned after 1974. On June 24, 1975, the flow at water-quality Station #2 was measured at 7.1 cfs. Attempts to measure flows at this station and the other water-quality stations on June 24, 1975 and subsequent to that date were unsuccessful because the stream velocities were too low to register on the measuring instrument.

To estimate design low flow for the Nonquon River near Port Perry for sewage assimilation, the Beaverton River near Beaverton (Station #02EC011; drainage area: 109 mi²) was selected as the index station. The Beaverton River Basin is the closest basin to the Nonquon River having similar physiographic features, and long-term stream-flow records. The estimates of minimum seven-day flows for the Nonquon River near Port Perry were pro-rated on the basis of drainage area size (Table 2).

WATER USE

The Nonquon River supports a warm-water biota and is used to assimilate sewage from the Port Perry lagoons. Recreation use includes fishing. Some species of sport fishes found in the Nonquon River are Muskellunge, Large-Mouth Bass, Perch, Pumpkinseed and Carp.

WATER QUALITY

There is one water-quality monitoring station on the Nonquon River, located at Seagrave (#17-0021-040-02). The

Table 1 - Stream-Flow Measurements, Nonquon River near Port Perry at Station #02HG101 (Station #1) (Drainage Area: 22 mi²; Period of Record: 1973 to 1974)

<u>1973 Data</u>		<u>1974 Data</u>	
Date	Flow (cfs)	Date	Flow (cfs)
May 24	6.4	Jun 20	5.8
May 28	65.0	Jul 12	3.3
Jun 11	8.4	Jul 24	1.6
Jun 27	11.0	Aug 9	0.0*
Jul 9	7.2	Aug 23	0.0*
Jul 23	2.8	Sep 13	0.0*
Aug 3	2.3		
Aug 20	6.8		
Sep 12	2.6		
Sep 17	1.4		
Oct 1	1.3		
Oct 15	4.7		
Oct 29	11.4		
Nov 1	16.2		
Nov 12	5.9		

* Stream-flow velocities were too low to register on measuring instrument.

Table 2 Estimated Streamflows for the Nonquon River near Port Perry (02HG101), Corresponding Permissible BOD₅ Loadings and Lagoon Effluent Discharge Rates
(Streamflows shown are minimum seven-day average values for indicated return periods and months)

MONTHS	7Q ₅ * cfs	BOD ₅ ** lb/day	7Q ₁₀ cfs	BOD ₅ lb/day	Effluent Q cfs MGD	
January	3.4	50	2.8	41	0.50	0.27
February	3.5	52	2.9	43	0.52	0.28
March	4.7	69	4.4	65	0.78	0.42
April	16.4	214	13.2	194	2.34	1.26
May	6.5	96	5.7	84	1.00	0.55
June	2.1	31	1.8	26	0.32	0.17
July	1.7	25	1.5	22	0.36	0.14
August	1.6	24	1.4	21	0.26	0.14
September	2.0	29	2.0	29	0.35	0.19
October	2.8	41	2.7	40	0.48	0.26
November	4.8	71	3.9	57	0.69	0.37
December	5.2	76	4.6	68	0.82	0.44

*7Q₅ = Minimum seven-day average flow for a return period of 5 years

**BOD₅ loads are based on a BOD₅ concentration of 15 mg/l for the effluent, upstream concentration of 2 mg/l and downstream concentration of 4 mg/l.

record for this station extends back to 1970. Over its six-year record, dissolved oxygen levels were less than 5 mg/l* on only four of 48 measuring dates; the lowest value was 2.4 mg/l (21/6/71 and 20/7/71). Average concentrations of total phosphorus and kjeldahl (as N) were 0.066 mg/l and 0.85 mg/l respectively.

A network of six water-quality monitoring stations was set up for the 1975 summer survey (Figure 1). Water samples were collected weekly at Stations 1, 2, 3 and 10 (effluent ditch) from June 5 to August 8, 1975 (Table 3 to 8). In addition, samples at all stations were collected at two-hour intervals over a 24-hour period during June 24 and July 15, 1975. A similar bi-hourly sampling program was conducted during a 12-hour period commencing at 2 p.m., July 30, 1975. These intensive sampling programs were conducted to obtain diurnal-nocturnal fluctuations of the water-quality parameters, and to compare these fluctuations with averages over prolonged intervals. A tri-hourly automatic water sampler and a continuously-recording dissolved oxygen-temperature meter were also installed at Station # 3 during June 27 to 29 and July 16 to 18, 1975.

The water quality in the Nonquon River above the Port Perry lagoon outfall (Station #1), as found during the 1975 survey, could be described as having sufficiently high concentrations of nutrients to cause biological

* MOE's criteria for a warm-water biota (Guidelines and Criteria for Water Quality Management in Ontario, 1974).

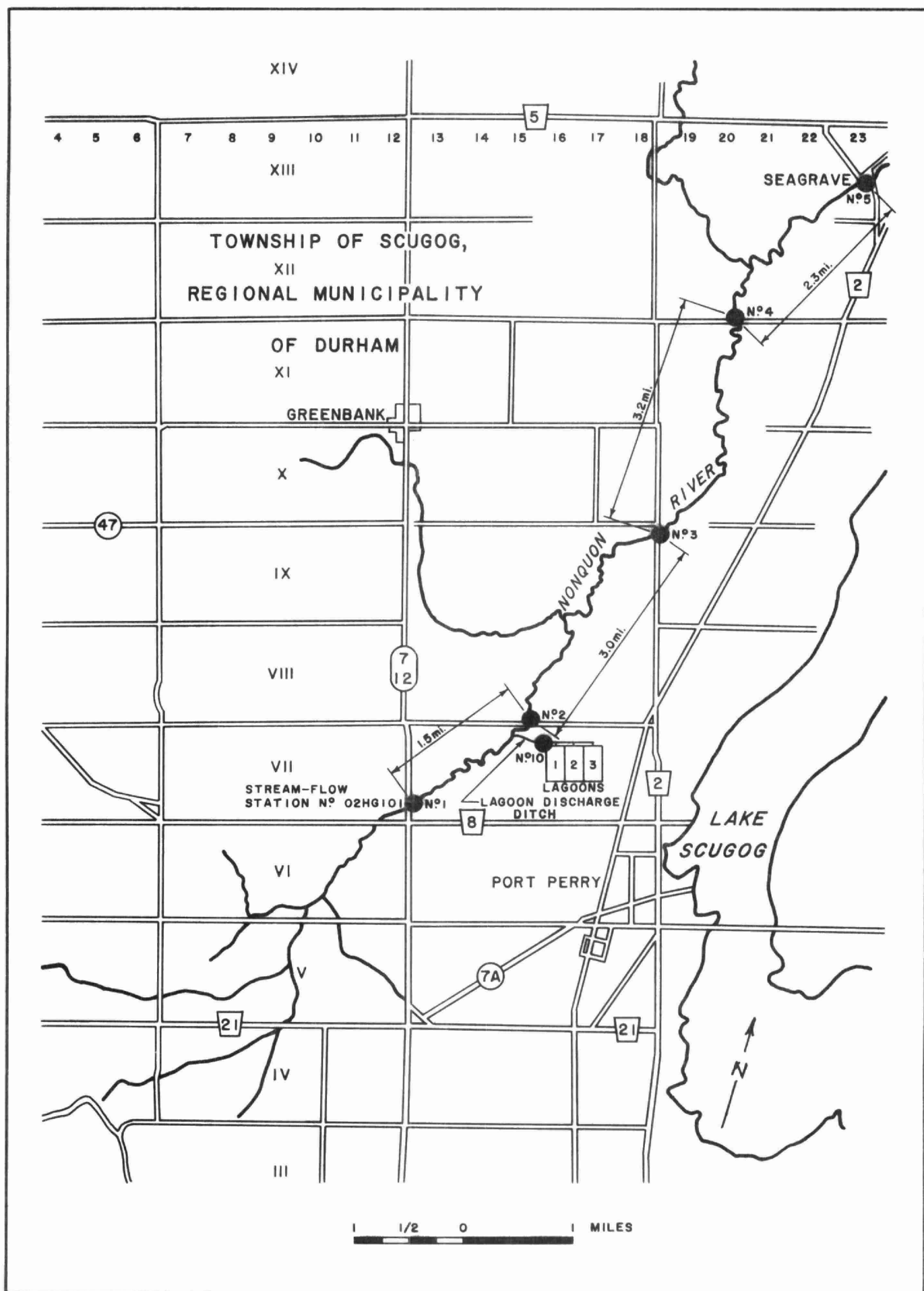


FIGURE 1 - LOCATION OF WATER QUALITY MONITORING STATIONS FOR THE 1975 SURVEY OF THE NONQUON RIVER

TABLE 3 - Nonquon River - 1975 Water-Quality Study
Station #1, Nonquon River at Highway #7

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
-	-	-	-	1.2	-	-	380	310	260	0.110	0.005	0.06	0.82	0.036	0.180	38	298	5/6/75	Grab
-	-	-	-	1.6	-	-	2,400	1,000	500	0.160	0.020	<0.10	1.30	<0.020	<0.200	30	175	11/6/75	Grab
-	-	-	-	0.6	-	-	-	-	-	0.070	0.060	0.30	1.90	0.100	0.500	20	265	20/6/75	Grab
7.0	9.1	5.8	24.7	1.6	1.8	1.4	1,570	157	135	0.085	0.010	0.06	0.74	0.027	0.180	28	293	24/6/75	24-hr intensive
-	-	-	-	1.0	-	-	200	90	10	0.500	<0.020	-	1.10	<0.020	<0.200	15	235	4/7/75	Grab
-	-	-	-	3.0	-	-	370	150	20	0.120	<0.020	<0.10	1.20	<0.020	<0.200	20	215	10/7/75	Grab
7.5	9.4	5.7	22.6	1.9	2.2	0.8	610	76	20	0.075	0.002	0.02	0.75	0.006	0.060	17	253	15/7/75	24-hr intensive
-	-	-	-	-	-	-	190	40	10	-	-	-	-	-	-	-	-	18/7/75	Grab
-	-	-	-	2.0	-	-	1,070	700	160	0.120	0.060	0.20	1.20	<0.020	<0.200	30	285	24/7/75	Grab
8.3	10.0	6.2	25.2	1.9	2.2	1.6	493	212	78	0.112	0.016	<0.01	0.83	0.009	0.100	16	258	30/7/75	12-hr intensive
-	-	-	-	2.0	-	-	110	40	70	0.080	<0.020	<0.10	2.20	0.020	<0.200	15	275	8/8/75	Grab
N.B. 1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																			

TABLE 4 - Nonquon River - 1975 Water-Quality Study
Station #10, Sewage Drainage Ditch

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
-	-	-	-	60.0	-	-	-	-	-	4.100	3.100	8.70	12.00	<0.020	<0.200	25	-	16/4/75	Lagoon Sample
-	-	-	-	7.0	-	-	640	100	80	2.700	2.200	1.50	7.40	0.580	0.530	5.5	540	5/6/75	Grab
-	-	-	-	26.0	-	-	15,600	1,500	50	2.700	2.700	2.50	7.90	2.000	1.200	30	145	11/6/75	Grab
-	-	-	-	11.0	-	-	-	-	-	3.100	2.400	2.40	6.10	0.220	<0.200	20	520	20/6/75	Grab
1.8	3.2	0.8	23.8	8.3	18.0	1.4	64,590	2,990	960	3.067	2.084	1.00	5.88	1.060	0.277	20	576	24/6/75	24-hr intensive
-	-	-	-	8.0	-	-	3,600	160	250	2.300	1.400	-	6.00	0.020	<0.200	15	535	4/7/75	Grab
-	-	-	-	10.0	-	-	19,000	1,500	2,100	2.700	1.800	1.30	7.00	<0.020	<0.200	15	590	10/7/75	Grab
4.7	5.9	3.3	22.8	9.5	20.0	4.4	626	75	76	3.200	2.700	1.60	4.80	0.376	0.620	25	700	15/7/75	24-hr intensive
-	-	-	-	-	-	-	6,800	400	280	-	-	-	-	-	-	-	-	18/7/75	Grab
-	-	-	-	4.5	-	-	200	70	350	5.000	3.400	3.20	16.00	<0.020	<0.200	55	615	24/7/75	Grab
2.1	2.4	1.8	25.8	28.6	75.0	2.4	3,680	> 300	>1,300	5.600	0.120	3.70	17.00	0.300	0.020	218	1735	30/7/75	12-hr intensive
N.B. 1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																			

TABLE 5 - Nonquon River - 1975 Water-Quality Study
Station #2, Nonquon River at Road Allowance between Concessions 7 & 8

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
-	-	-	-	1.0	-	-	-	-	-	0.026	0.002	0.01	0.44	0.007	0.650	-	-	16/4/75	Grab
-	-	-	-	0.8	-	-	310	70	50	0.100	0.059	0.04	0.52	0.005	0.010	2.4	270	5/6/75	Grab
-	-	-	-	1.6	-	-	100	60	60	0.210	0.100	<0.10	0.80	<0.020	<0.200	5.0	225	11/6/75	Grab
-	-	-	-	0.4	-	-	-	-	-	0.180	0.140	0.20	0.90	0.020	<0.200	<15	-	20/6/75	Grab
2.2	3.6	0.8	23.3	1.6	2.0	1.0	414	35	74	0.207	0.129	0.07	0.84	0.006	<0.010	9.0	344	24/6/75	24-hr intensive
-	-	-	-	1.6	-	-	930	130	10	0.280	0.020	-	1.80	<0.020	<0.200	55	295	4/7/75	Grab
-	-	-	-	3.5	-	-	4,000	50	170	0.280	0.100	0.100	1.60	<0.020	<0.200	20	370	10/7/75	Grab
5.4	9.1	1.3	21.5	4.4	10.0	1.4	653	125	150	0.450	0.240	0.140	1.40	0.003	<0.010	14	293	15/7/75	24-hr intensive
-	-	-	-	-	-	-	100	20	20	-	-	-	-	-	-	-	-	18/7/75	Grab
-	-	-	-	3.0	-	-	1,600	160	960	0.560	0.200	<0.100	2.00	<0.020	<0.200	25	340	24/7/75	Grab
5.1	7.4	1.6	23.6	2.1	3.6	1.0	490	100	166	0.330	0.140	0.080	1.40	0.005	<0.010	10	288	30/7/75	12-hr intensive
-	-	-	-	5.0	-	-	100	90	40	0.600	0.020	0.200	3.50	<0.020	<0.200	50	340	8/8/75	Grab
N.B. 1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																			

TABLE 6 - Nonquon River - 1975 Water-Quality Study
Station #3, Nonquon River at Road Allowance between Lots 18 & 19, Concession 9

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
-	-	-	-	1.0	-	-	100	70	20	0.110	0.065	0.01	0.70	0.005	0.010	1.9	270	5/6/75	Grab
-	-	-	-	2.5	-	-	70	30	10	0.120	0.040	<0.10	1.30	0.040	<0.200	5.0	215	11/6/75	Grab
-	-	-	-	1.4	-	-	-	-	-	0.110	0.080	0.10	0.90	<0.020	<0.200	5.0	245	20/6/75	Grab
7.1	9.3	5.2	24.6	1.3	1.4	1.2	145	57	83	0.115	0.082	0.06	1.17	0.009	<0.010	3.0	334	24/6/75	24-hr
7.4	10.2	5.0	23.2	2.4	3.0	2.2	-	-	-	0.108	0.029	<0.01	1.19	0.003	<0.010	5.0	363	27/6/75	intensive
6.5	9.2	3.9	23.2	2.8	4.0	2.2	-	-	-	0.099	0.032	<0.01	1.08	0.003	<0.010	6.0	393	28/6/75	Auto-
5.9	9.2	3.6	23.3	2.6	2.6	2.6	-	-	-	0.160	0.022	<0.01	1.30	0.004	<0.010	14	392	29/6/75	Sampler
-	-	-	-	1.4	-	-	1,900	1,400	260	0.160	0.040	-	1.60	<0.020	<0.200	15	305	4/7/75	Grab
-	-	-	-	3.0	-	-	11,000	2,800	550	0.200	0.040	<0.01	1.60	<0.020	<0.200	10	305	10/7/75	Grab
9.1	13.2	5.0	22.4	2.4	2.8	2.0	1,255	202	110	0.120	0.020	0.24	1.40	0.002	<0.010	8	310	15/7/75	24-hr
4.5	5.4	3.4	23.7	5.2	7.0	3.2	-	-	-	0.120	0.110	<0.01	1.30	0.002	<0.010	-	-	16/7/75	intensive
3.7	4.8	2.5	23.8	5.4	14.0	2.6	-	-	-	0.120	0.009	<0.01	1.50	0.002	<0.010	-	-	17/7/75	Auto-
3.1	5.0	1.4	24.0	4.7	5.5	3.4	2,400	380	60	0.140	0.010	<0.01	1.50	0.002	<0.010	-	-	18/7/75	Sampler
-	-	-	-	2.2	-	-	2,900	510	590	0.180	0.100	0.20	1.40	<0.020	<0.200	5	325	24/7/75	Grab
7.0	10.4	3.7	26.9	1.7	2.4	1.2	9,460	5,460	1,030	0.082	0.029	<0.01	0.91	0.008	0.070	27	277	30/7/75	12-hr
-	-	-	-	1.4	-	-	400	140	120	0.120	0.020	<0.10	3.00	<0.020	<0.200	15	345	8/8/75	intensive
N.B	1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																		

TABLE 7 - Nonquon River - 1975 Water-Quality Study
Station #4, Nonquon River at Road Allowance between Concessions 11 and 12

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
7.2	10.6	3.7	25.3	1.3	1.8	1.0	419	33	106	0.096	0.061	0.02	0.90	0.006	<0.010	8	290	24/6/75	24-hr intensive
6.6	9.4	3.3	22.0	1.6	2.2	1.0	558	42	75	0.110	0.036	0.23	1.40	0.002	<0.010	4	263	15/7/75	24-hr intensive
6.8	9.5	3.6	24.4	1.2	1.4	1.0	298	28	116	0.054	0.041	<0.01	1.2	0.005	0.010	3	315	30/7/75	12-hr intensive
N.B.	1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																		

TABLE 8 - Nonquon River - 1975 Water-Quality Study
Station #5, Nonquon River at Seagrave

DISSOLVED OXYGEN(MG/L)			TEMP. °C	BOD ₅			BACTERIAL/100 ml			PHOSPHOROUS		NITROGENS				S.S.	T.S.	DATE	RUN
MEAN	MAX.	MIN.		MEAN	MAX.	MIN.	TOTAL	FECAL	STREP.	TOTAL	SOL.	F.A.	KJEL.	NITRITE	NITRATE				
6.6	8.7	4.4	25.5	1.6	2.0	1.4	691	210	76	0.106	0.032	0.03	0.92	0.011	< 0.010	20	290	24/6/75	24-hr intensive
7.0	8.5	5.4	22.3	1.9	2.2	1.2	556	191	73	0.110	0.016	0.20	1.20	0.002	< 0.010	23	287	15/7/75	24-hr intensive
9.1	11.2	7.7	23.2	1.5	2.4	0.8	814	221	114	0.064	0.028	<0.01	0.97	0.004	0.010	10	323	30/7/75	12-hr intensive
N.B.	1. For intensive sampling, bacteria counts are geometric means. 2. For intensive sampling, all other parameters are arithmetic means.																		

nuisances, e.g. total phosphorus was more than 0.1 mg/l, dissolved oxygen levels sufficiently high to support a warm-water fishery (more than 5 mg/l), BOD₅ less than 4 mg/l, and suspended solids usually exceeding 15 mg/l.

The quality of the final lagoon effluent during the survey indicated dissolved oxygen concentration ranged from 0.8 mg/l to 5.9 mg/l (Table 4). BOD₅ concentrations fluctuated from 1.4 mg/l to as high as 75.0 mg/l. During the July 30 12-hour sampling program, the mean BOD₅ was 28.6 mg/l; the maximum value was 75.0 mg/l and the minimum 2.4 mg/l. Suspended solids were generally in excess of 15 mg/l. Both nutrient and bacteria levels were high. It must be noted; however, that the effluent did not receive chemical treatment prior to being discharged. The rates of effluent discharges during the survey were as follows:

<u>Period</u>	<u>Discharge Rate</u>	
	gallons/day	cfs
June 1 to 17	650,000	(1.21)
June 17	1,400,000	(2.60)
June 18 to 25	1,680,000	(3.12)
June 25 to July 8	900,000	(1.67)
July 8 to 17	750,000	(1.40)
July 17 to August 6	300,000	(0.56)

The most significant impact of Port Perry's effluent on downstream water quality was the reduction in dissolved oxygen from values greater than 5 mg/l at Station #1 to as low as 0.8 mg/l at Station #2, 1.4 mg/l at Station #3 and 3.3 mg/l at Station #4 (Tables 5, 6 and 7). During

the 24-hour intensive sampling program on June 24, 1975, the mean dissolved oxygen concentration was only 2.2 mg/l at Station #2; for the period July 16 to 18, the mean 24-hour D.O.'s at Station #3 were 4.5 mg/l, 3.7 mg/l and 3.1 mg/l respectively. Dissolved oxygen concentrations below 4 mg/l for prolonged periods could have a detrimental effect on the warm-water biota in the Nonquon River; the extremely low concentration of 0.8 mg/l at Station #2 on June 24 was considered to have been in the lethal range for many warm-water species of fish.

Mean 24-hour BOD₅ concentrations in excess of 4 mg/l were measured at Stations #2 and #3. Concentrations for individual samples were as high as 10 mg/l at Station #2 and 14 mg/l at Station #3. At the other downstream stations, BOD₅'s were usually less than 4 mg/l.

Nutrient levels in the stream water increased significantly from Station # 1 to Station # 2 and this was believed to be largely due to the effluent from the Port Perry lagoons. Nutrient levels then decreased downstream from Station # 2 (Figure 2 & 3). The general decrease in nutrient concentrations in downstream waters was indicative of the low stream flows and velocities which did not provide significant flushing of the stream, and thus allowed the nutrient to become incorporated into the macrophyte community and some settling of sediments in the stream bed.

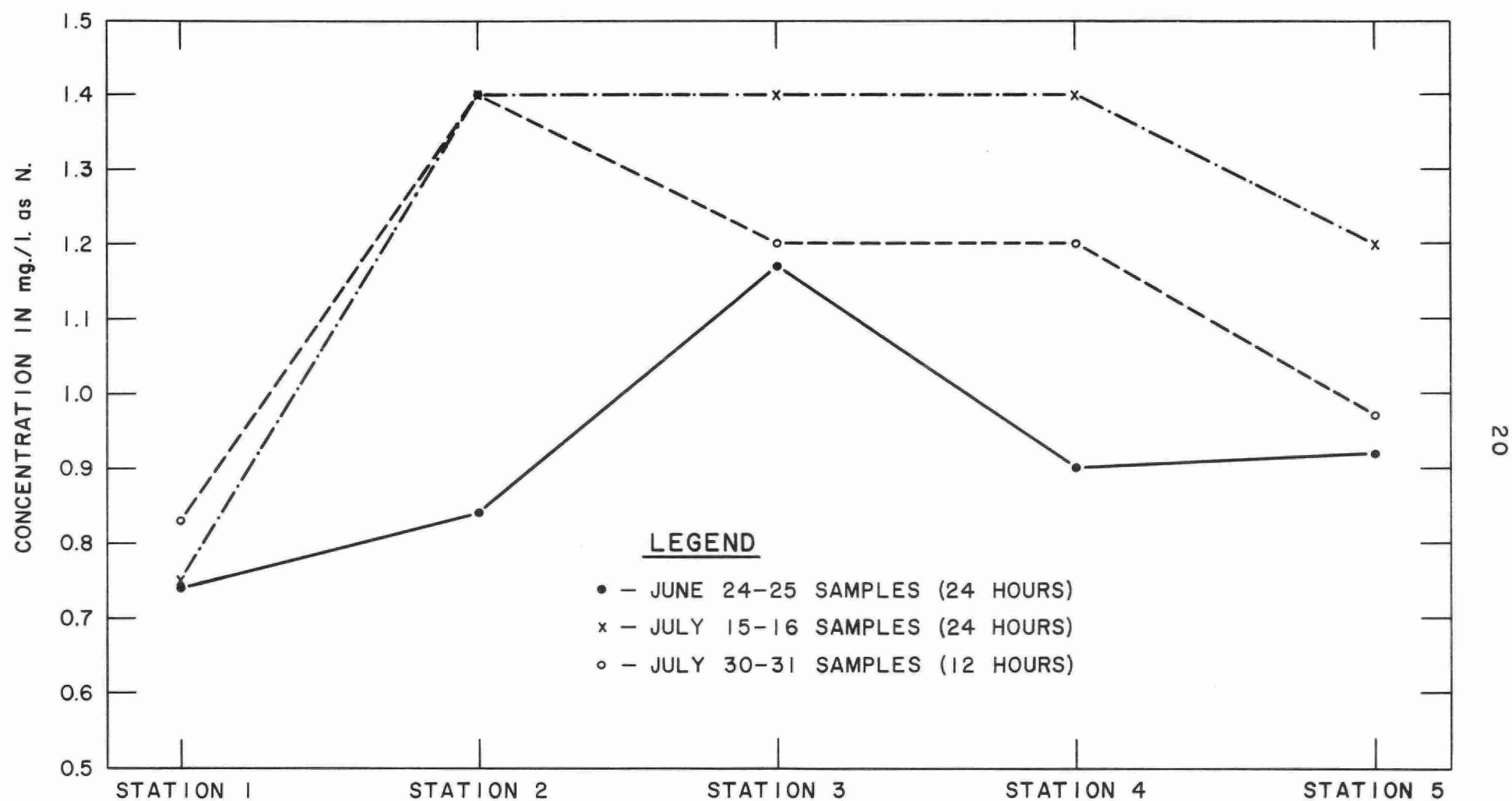


FIGURE 2 - MEAN CONCENTRATION OF KJELDHAL NITROGEN IN THE NONQUON RIVER

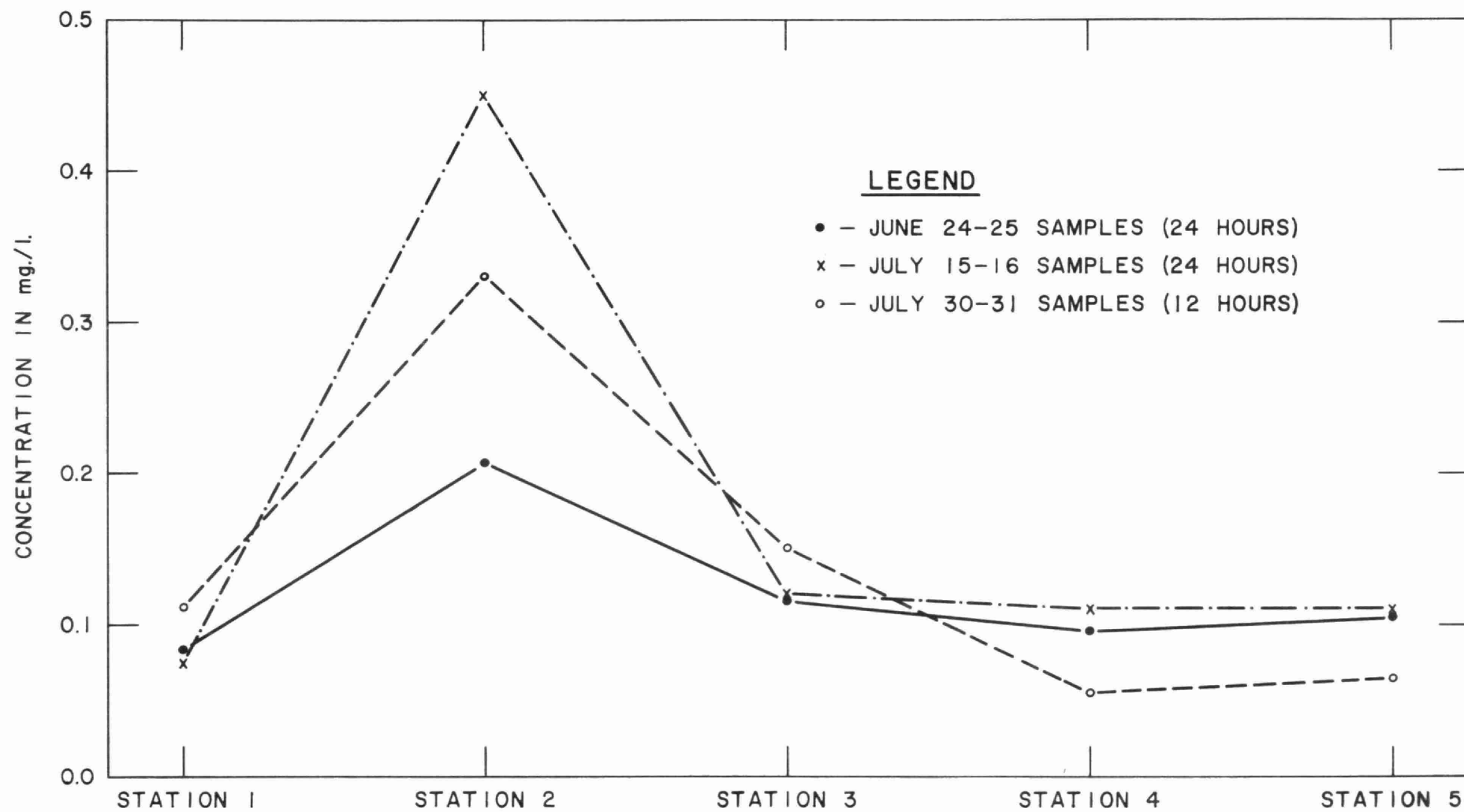


FIGURE 3 - MEAN CONCENTRATION OF TOTAL PHOSPHORUS IN THE NONQUON RIVER

ALLOWABLE BOD₅ LOADS

The BOD₅ concentrations in the Nonquon River upstream of the Port Perry sewage outfall was about 2 mg/l during the 1975 survey. Based on a final effluent quality of 15 mg/l BOD₅, organic loads and the corresponding lagoon discharge rates were calculated for each month (Table 2).

The present sewage inflow to the Port Perry lagoons is about 320,000 gallons per day (0.60 cfs). For an effluent with 15 mg/l BOD₅ and a flow equal to the estimated 7Q₁₀, a continuous effluent discharge comparable to the present average inflow to the lagoons could probably be assimilated satisfactorily during March, April, May, November and December. For an April 7Q₁₀ of 13.2 cfs, each lagoon cell (15 acres x 5 feet) would have to be emptied over a 16-day period.

The allowable BOD₅ loads as calculated did not take into account the temperature difference between winter and summer. Because biological and chemical activities in the stream are slower at lower temperatures, the allowable loads for the winter months were probably under-estimated, and those for the summer months over-estimated. Therefore, it might be feasible to use the flows for the return period of 5 years instead of 10 years for winter discharges.

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ONTARIO

MINISTRY OF THE ENVIRONMENT

Water Quality of the Nonquon River
in Relation to Sewage Lagoon
Discharge form Port Perry-
Regional Municipality of Durham
Choo-Ying, A.V. 1976

~~TERMINAL STREAM: TRENT R.~~

DATE

ISSUED TO

17/10/79

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Date Due
